

## ABSTRACT

Embodiments include a process and composition for improved capacity retention of a lithium-ion battery. Embodiments include a surface/chemical modification of electrode materials. In certain embodiments the  $\text{LiMn}_2\text{O}_4$  spinel oxide is modified with  $\text{Li}_x\text{CoO}_2$ ,  $\text{Li}_x\text{Ni}_{0.5}\text{Co}_{0.5}\text{O}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{Cr}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{MgAl}_2\text{O}_4$  or combinations thereof using a chemical processing procedure followed by heat treatment. The surface/chemically modified  $\text{LiMn}_2\text{O}_4$  show an improved capacity retention at room temperature and at elevated temperatures. In certain embodiments,  $\text{Li}_x\text{Ni}_{0.5}\text{Co}_{0.5}\text{O}_2$ -modified  $\text{LiMn}_2\text{O}_4$  demonstrates improved capacity retention. In other embodiments,  $\text{Al}_2\text{O}_3$ -modified  $\text{LiMn}_2\text{O}_4$  demonstrates a higher capacity under certain conditions. In other embodiments the  $\text{Li}_{0.75}\text{CoO}_2$ -modified  $\text{LiMn}_2\text{O}_4$  demonstrates a combination of improved capacity value and retention. In another embodiment the  $\text{LiCoO}_2$  layered oxide is modified with  $\text{Al}_2\text{O}_3$  or  $\text{Li}_{1.05}\text{Mn}_{1.9}\text{Ni}_{0.05}\text{O}_4$  using a chemical processing procedure followed by heat treatment. The surface/chemically modified  $\text{LiCoO}_2$  shows much higher capacity of approximately 190 mAh/g in the range of 4.5 to 3.2 V with good capacity retention.